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ADDITIONAL STUDIES IN ARRESTED EVOLUTION

BY RUDOLPH RUEDEMANN

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Communicated by J. M. Clarke, January 29, 1922

In a former paper on the "Palaeontology of Arrested Evolution,"¹ the writer has traced the causes of *persistence* in animals as seen from the viewpoint of the palaeontologist.

A number of conclusions as to the distribution of persistent types in the different classes and as to the probable causes of persistence were there obtained by a statistical method, in which the genera persisting through more than two geological periods were utilized. Two entirely different groups of such persistent genera were distinguished and these were termed *persistent radicles* and *persistent terminals*. The former are primitive central stocks, still adapted to a variety of conditions; the latter post-climacteric types which have become fixed in their characters by having found stable physical surroundings, or by gerontic conditions, loss of variability, etc.

In continuation of these studies the writer has investigated the possible influence recorded in fossils, of the different modes of propagation upon the persistence of types and has found that all the lower modes of propagation, viz., propagation by simple division, by budding, by hermaphrodites and by parthenogenesis, are distinctly favorable to persistence, mainly through diminution in the frequency and range of variability as far as it is induced by fertilization.

In trying to trace the persistence of types to its ultimate causes, beyond the processes of heredity, ontogeny, environment and selection, around which the life and evolution of animals may be said, with H. F. Osborn, to center, it was found that the process of selection may account for the cases of persistence where variability has been reduced to a minimum by the modes of propagation mentioned before; and that environment accounts for resistance in those cases where it has become so stable as to lack the actual stimulus for further development or change of form. But it is obvious that there are still more important factors involved in heredity and ontogeny that make for persistence in organisms, especially as that is shown in the post-climacteric forms, or persistent terminals. And above all, none of the four factors, selection, environment, heredity and ontogeny, gives any clue to the actual mechanics of the processes that induce persistence in types.

Such explanation of persistent types and a clue to the mechanics of the processes involved is intimated in the views recently advanced on the methods of inheritance and production of new characters by means of the genes or character-determiners of the heredity-chromatin. Dürken and

Saalfeld² hold that external influences act first upon the cytoplasm (protoplasm) of the cells, and especially of the germ-cells, producing inceptive genes (plasmogenes) which finally become true genes of the heredity-chromatin when the long-continued strain has passed a certain "threshold." This final abrupt change would well account for the abrupt appearance of new characters in the ontogeny, or the salto-mutations of De Vries and the constancy of persistent types under stable external conditions. Likewise the fact that the cytoplasm is known to influence the heredity-chromatin of the nucleus, or the genes, would explain the absence of flucto-mutations or variations under stable conditions. Persistent types are then either forms in which through lack of external stimulation no changes arise in the cytoplasm that produce new genes; that is, forms in which the cytoplasm is not able to react any more to external influences and differentiation could take place only through loss of genes or a combinative mode of production of new genes. This latter method leads to so-called "self-differentiation" and thereby to the excessive terminal forms of series, or to terminal persistent types, in which latter case absolute rigidity of the forms would result from the entire failure of acquisition of new genes and gerontic rigidity in the old ones.

The persistent radicles, on the other hand, correspond to the extreme development of what Saalfeld, from his studies of ammonites, terms "Konservativreihen." These are series in which the salto-mutations appear in very long intervals, while the numerous side-branches (which furnish the index-fossils) develop by rapid salto-mutations. These persistent radicles are therefore able to undergo new periods of explosive and climacteric development (Virenz-perioden of Wedekind) and are thus still less absolutely persistent than the persistent terminals.

¹ Presidential address before The Palaeontological Society, Albany meeting 1916, *N. Y. State Mus., Bull.* **196**, 1918 (107-38).

² *Die Phylogenes Fragestellungen zu ihrer exakten Erforschung.* Berlin. Gebr. Bornträger. 1921.

NEW FORMS OF LIFE FROM THE SILURIAN

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The silurian of New York (Bertie waterlime and Lockport limestone) have recently yielded some extraordinary fossils which are now under investigation.

There are algae with well-preserved air-bladders, and primitive land-plants with thick coaly tissue. The graptolites, however, are the most striking: Dictyonemas, a foot and more in diameter, and varied types of the Inocaulis group. The latter possess thickly sheathed, glove-finger